TITLE: **Relating Black Ash (*Fraxinus nigra*) Decline and Regeneration to Tree Age and Site Hydrology**

LOCATION: Minnesota

DURATION: Year 2 of 2-year project FUNDING SOURCE: Base

PROJECT LEADER: Brian Palik, USDA Forest Service, Northern Research Station, 218-326-7116, bpalik@fs.fed.us

COOPERATORS: M.Ostry, R.Venette, USDA Forest Service, Northern Research Station, Forestry Depts. Lake, St. Louis and Itasca counties, M. Benedict, BIA, St. Paul, MN, D. Prettyman, Natural Resource Services, Duluth, MN.

FHP SPONSOR/CONTACT: Manfred Mielke, ST. Paul, MN, 651-649-5267, mmielke@fs.fed.us

PROJECT OBJECTIVES:

1. Using field data collected in 2006-07, relate decline and regeneration occurrence to site level hydrology and edaphic factors, tree age, and growth. 2. Using MN tribal data in the BIA CFI database elucidate temporal patterns of decline across the region. 3. Analyze all data and prepare papers for publication.

JUSTIFICATION: Our proposed project addresses the selection criteria as follows:

a. The project is directly linked to FHM detection monitoring, which is indicating widespread black ash decline in parts of the region;
b. Geographic scale: black ash is wide-spread in the mid-west and northeastern region. Our results will be useful for interpreting decline patterns over much of this region.
c. Biological impact and/or political importance. Black ash is a significant tree component of riverine and palustrine wetlands throughout the region. Its decline and widespread mortality will fundamentally alter the function of these ecosystems and result in a reduction in availability of a unique timber resource, as well as a valued source of wood for native American basketry.
d. Results we have obtained in a previously funded study of this problem have revealed that site factors and the age of affected trees may be critical variables determining the incidence of decline and level of black ash regeneration. The field sampling protocols we have developed, when applied to the project outlined in this proposal, will result in a high probability of successfully testing our ideas about the underlying causes of black ash decline.

DESCRIPTION:

a. Background:

Black ash decline has been noted in the upper mid-west and the northeast (Livingston and White 1997; USDA Forest Service 2004). May drought has been implicated (Livingston et al.

1995; Livingston and White 1997). It is at this time that ring-porous species, including black ash, fill new vessels prior to leaf expansion. Drought stress during this critical period may weaken trees, leading to decline mortality. There is not a good understanding of how decline varies within the region, or how landscape factors may predispose trees to stress. For example, the probability of drought stress varies as a function of climatic, physiographic, and edaphic variation. Understanding if decline varies in relation to mapped spatial data that integrates these landscape characteristics will facilitate development of models to predict the occurrence of decline phenomena.

There are several regional factors that make understanding black ash decline more complex, but also a priority. First, black ash most often occurs in wetlands that once supported American elm. Loss of a second dominant tree species from these ecosystems would likely have consequences on ecosystem function. Being able to predict when and where loss may occur will be important ecologically. Second, the emerald ash borer (EAB) is now causing significant ash mortality in parts of the region. Despite best efforts to halt its spread, the possibility exists that this exotic pest will impact ash over a wider geographic area in the Lake States region. Understanding black ash decline prior to potential impact from EAB will be important for understanding the true ecological impact of this pest. In addition, several non-native invasive plant species may invade black ash sites if the loss of black ash results in conditions suitable for their establishment and spread. Finally, mortality of black ash in wetlands often is associated with cultural features that disrupt site hydrology, e.g., roads that block flow across a wetland, causing one side of the road to be too wet.

Preliminary observations suggest that black ash growing on better-drained soils are not experiencing decline. Understanding how site level factors contribute to black ash decline is important for understanding the severity of a regional, drought induced decline phenomenon. Additional factors that may contribute to the incidence of decline are the age of trees and the size of the wetland where black ash are growing. Cumulative stress events over time such as droughts or flooding may affect older trees disproportionately compared to younger trees. Large wetlands may buffer the effects of occurrences of drought more effectively than smaller areas resulting in less severe stress and damage to trees.

b. Methods: We have utilized data derived from FIA/FHM plots, as well as available mapped spatial data on landscape ecosystems. We are targeting variously impacted ecosystems in Minnesota for field evaluation, quantifying percent decline and mortality at selected sites. Over 30 years of CFI data for black ash growth and regeneration on tribal lands in MN has been made available to us. Finally, at the field locations, we are relating black ash decline severity to edaphic and hydrologic factors, tree age and cultural features that may have altered site hydrology, including road location and constructed drainage and recent timber management activities.

c. Products: This project will produce 1) a predictive understanding of the relationship between decline probability and site level characteristics (hydrology, soil); 2) on-the-ground assessments of actual decline and mortality severity within regional ecosystems that are dominated by black ash currently; 3) guidance as to the importance of on-site cultural features at increasing decline probability; and 4) one or more peer-reviewed manuscripts

d. Schedule of Activities: Field sampling of black ash decline and mortality and regeneration in selected rich mesic and wetland ecosystems in MN was completed in late summer 2007 and

identification of cultural features potentially influencing hydrology at selected field sites is ongoing. This fall and winter we will analyze and summarize field data from our plots and the BIA CFI. We will continue to prepare and examine tree cores for growth of trees across the field sites and to relate weather and hydrological events to tree growth and decline patterns. Finally we will analyze data and prepare papers of results for publication.

Progress/Accomplishments: Preliminary Results (2006 field data).
Our initial summarization of 2006 stand level data from 21 sites in northern Minnesota shows a clear differentiation between sites with declining ash and sites with relatively healthy trees. The distinction seems to be independent of geographic location. There is a significant difference between the declining sites with declining trees and sites with healthy trees in several measures indicative of site hydrology. Decline is substantially more prevalent on sites that are wetter, but much less prevalent on relative dryer sites.

Sampling efforts in 2007 focused on adding additional field sites that spanned a range of moisture conditions across a broad area of northern Minnesota. We sampled an additional 31 sites, collecting data on decline status, tree sizes and ages, associated plant communities, and site characteristics on over 100 plots. We will add these data to the 2006 field data for a more extensive examination of geographic variation in decline.

To date, we have obtained data on black ash growth, regeneration and incidence and extent of decline from the following sources: 3 FIA cycles, BIA CFI database, FHM-DNR ash decline aerial sketch map, and from nearly 200 field plots we have established in Carlton, Aitkin, St. Louis, Lake and Itasca counties.

Results from the analyses of FIA field plot data from 1977-2005 for MN were presented in a proceedings paper (Ward, K., Ostry, M., Venette, R., Palik, B., Hansen, M. and Hatfield, M. Assessment of black ash (Fraxinus nigra) decline in Minnesota-in press)

Trends in the data we have collected in 2007 are similar to those of 2006. Black ash growing on wetter plots (sites with standing water or saturated soils) had greater decline symptoms than trees growing on drier plots. A study of white ash decline in Massachusetts revealed that declining ash were most prevalent on mesic sites subject to large fluctuations in soil moisture (Woodcock et al. 1993). Many of the black ash sites we have taken plot data in are now experiencing or have in the past, periodic changes in soil moisture with some swamp sites having no standing water. Severity of decline on visited plots was generally less in younger (<100 yrs) trees (based on tree size and limited core analysis to date) than in older trees. Black ash regeneration (seedling and sapling size classes) varied widely across sites but was generally greater on better drained sites. Non-declining black ash were found growing together on rich mesic sites along with aspen, sugar maple and other upland species indicating that black ash, while most frequently found growing on wetland sites where it can capture the site, is able to thrive on other sites if competition for light from other species is not a factor early in stand development. Studying the history of the origin and management of these stands may yield useful information as to manage existing black ash stands as well as how to recruit black ash on additional sites to increase species diversity and to conserve and protect the black ash resource from potential future threats such as the emerald ash borer and climate change. To date, no insect pests or diseases have been associated with declining black ash stands.

FY 08 COSTS:	Item	Requested FHM EM Funding	Other-Source Funding	Source
Administration	Salary		$7800	NRS
	Overhead	$6450		
	Travel		$500	NRS
Procurements	Contracting	$36550		
	Equipment			NRS
	Supplies		$300	
Total		$43000	$8600	

Literature Cited

Livingston, W. H. A. Hager, A. S. white, and D. Hobbins. 1995. Drought associated with brown ash dieback in Maine. Phytopathology 85: 1558.

Livingston, W. H., and A. S. White. 1997. May drought confirmed as likely cause of brown ash dieback in Maine. Phytopathology 87: 559.

U.S.D.A. Forest Service. 2004. Lake States forest health watch. USDA Forest Service, Northeastern Area State and Private Forestry. August 1, 2004.

Woodcock, H., W.A. Patterson III, and K.M. Davis, Jr. 1993. The relationship between site factors and white ash (Fraxinus americana L.) decline in Massachusetts. For. Ecol & Mgmt. 60:271-290.